

HTPD 2018



Contribution ID : 398

Type : not specified

6.19 Conceptual design of extended magnetic probe set to improve 3D field detection in NSTX-U

Tuesday, 17 April 2018 10:31 (120)

Adding toroidal arrays of magnetic probes at the top and bottom of NSTX-U would improve both the detection of the multimodal plasma response to applied magnetic perturbations and the identification of the poloidal structure of unstable plasma modes, as well as contribute to the validation of MHD codes. Analysis of the existing toroidal arrays on NSTX-U shows coverage of the torus is sufficient to simultaneously measure toroidal mode numbers up to $n=3$, but not to resolve the poloidal structure. The MHD code MARS-F/K has been used to identify poloidal locations that would improve the capability to measure stationary or near-stationary 3D fields that may result from the plasma response to external sources of non-axisymmetric fields. The study highlighted 6 poloidal positions where new arrays of both poloidal and radial magnetic field sensors will improve the poloidal resolution. Basing the sensor connection scheme on differences of pairs of probes and on the singular value decomposition condition number would allow a clear measurement of asymmetric signals. We propose configurations that would provide both a good signal/noise ratio and a good resilience of the array to the failure of a sensor. Supported by US DOE under grants DE-FC02-04ER54698, DE-FG02-99ER54522, DE-AC02-09CH11466.

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Session Classification : Session #6, Tuesday Morning Poster Session